TEXTILE RESEARCH

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March 10, 1933

Mr. Charles H. Clark, Sec'y.,
The United States Institute
for Textile Research,
Boston, Mass.

Dear Mr. Clark:-

I congratulate you on the very interesting March issue of "TEXTILE RESEARCH". This has a great deal of valuable matter and I think you are doing a great service to the industry in carrying on such a publication.

Very sincerely yours,

Franklin W. Hobbs

U. S. Institute for Textile Research, Inc., is grateful to the Chairman of The Textile Foundation for his evaluation of the service that "Textile Research" is giving to the textile industry.—Editor.

TEXTILE RESEARCH

EDITORIAL

Utilization of Basic Research Results

THE fact that, despite depressed business conditions, fundamental research is being fully maintained by such of its outstanding exponents and beneficiaries as the American Telephone & Telegraph Co., and E. I. du Pont de Nemours & Co., Inc., is emphatic evidence that they have found in its continuance the greatest assurance of further progress and economy. Although fundamental research, or the development of new basic knowledge, cannot be depended upon to sychronize its practical results with the advent of a serious business depression, it is at such times that its need and possibilities are most evident, and it is one of the last important business functions that those who have been its beneficiaries will curtail voluntarily.

Because the domestic textile industry has been satisfied to rely upon outsiders to develop its new fundamental knowledge, and has only recently been provided with the opportunity to engage in basic scientific research in a limited way, there is no direct analogy, as regards research policies, to be drawn between it and the two big corporations mentioned. It is none too early, however, for research-minded textile men to endeavor to orient themselves and their business policies with the limited research work in progress. Because a comparatively virgin research field is being cultivated it is not impossible that results having important application may become available sooner than is generally anticipated. Who are prepared to apply such new knowledge and profit by it?

U. S. Institute, The Textile Foundation and the various educational and governmental bodies engaged in basic textile re-

search are either unauthorized, or unable, to engage in the inventive and developmental work required to apply to practical use the results of fundamental research. Some of the results, it is true, may almost explain their practical application, but in most cases they will require additional developmental work demanding the combined efforts of scientists and expert technicians having adequate laboratory equipment. Will manufacturers individually or cooperatively undertake such developmental work, or will they rely as heretofore upon chemical and machinery firms, commercial laboratories, or other agencies to perform these necessary functions?

Certain of this developmental work must necessarily and logically be done outside of the mills, but that which has to do with new products, or with new processes and their control, is essentially a mill job, and those mills that anticipate this function will be those which, in future years, may be expected to include in their annual reports references to fundamental research similar to that quoted on the front cover of this issue.

Unpublished Researches

CONSIDERABLE interesting and important textile research has been done in this country that has never been published. Some that was never carried to conclusion may be more important to future workers than some other work that was concluded, because the former may disclose factors that should be avoided, or that need not be duplicated again. Your Board of Editors has some reports of the latter character that will be published eventually in abstract form, and they are desirous of receiving, with the privilege of publication, all unpublished textile research work.

An important piece of research work never published previously in complete form appears in this issue under the title "Bursting and Grab Tests for Knit Fabrics Compared." It is a paper that was presented in 1925 before Committee D-13 of the American Society for Testing Materials. It is hoped that authors of equally meritorious work that has not yet been published, or those who may know of such work, will communicate with the Board of Editors and aid them in their efforts to increase the supply of textile source material.

Bursting and Grab Tests for Knit Fabrics Compared

By B. H. FOSTER

Publication of important textile research work previously unpublished is one of the functions of this magazine. The accompanying paper was presented by the author before Committee D–13 of the American Society for Testing Materials, February, 1925, but only excerpts therefrom [1] *have been published heretofore.*

In 1925 Committee D–13 of the A. S. T. M. adopted tentatively the 1 × 1 × 1" Grab Test, [2] *and at that time the Bureau of Standards recommended,* [3] *and the Associated Knit Underwear Manufacturers of America generally adopted* [4] *this test method. In 1928, however, the A. S. T. M. revised the tentative specifications in favor of a bursting test.* [5]

FOR many years there was considerable discussion as to whether the grab test or the bursting test was the better method for determining the strength of knit fabrics. For the purpose of obtaining data which might be of some assistance in deciding on the most satisfactory strength test, bursting tests and grab tests were made by the author in 1924–25 on the following types of knit fabric:

1. Single Thread Worsted Jersey; 2. Double Thread Worsted Jersey; 3. Pink Corset Net; 4. 6½ Cotton Net; 5. 4½ Cotton Net; 6. 3½ Cotton Net.

In addition to comparing the bursting test with the grab test, the samples were tested on three bursting machines, having diaphragms of different diameters, to study the effect of varying the size of the diaphragm. The three bursting machines, all of which were of the hydraulic type, were:

1. Regular Mullen Tester—1¼" diaphragm
2. Special Bursting Machine—4" diaphragm
3. Special Bursting Machine—8" diaphragm

Conclusions

Comparison of Grab Test vs. Bursting Test:

1. The bursting strength for any knit fabric, expressed as so many lbs. per inch of width, is equal to the strength in lbs. of the courses obtained by the $1 \times 1 \times 1''$ Grab Test.
2. Therefore, the bursting test as applied to knit fabrics boils down to be a strength test of the courses only.
3. The Grab Test has the advantage of testing the strength in both the wales and courses directions.

Comparison of the Three Sizes of Bursting Machines:

4. The indicated gauge reading is the sum of the lbs. per sq. in. of fluid pressure necessary to break the fabric plus that which is required to stretch the rubber diaphragm.
5. For the same fabric, the smaller the diaphragm the greater is the indicated pressure required to break it. Therefore, the rubber diaphragm in the smaller machine must be correspondingly stronger in order to stand the strain of rupture without breaking.
6. The diaphragm error is then larger for the Mullen Tester than for the 4- or the 8-inch machine.
7. The indicated gauge reading, minus the diaphragm error, gives the true lbs. per sq. in. of fluid pressure that is required to break a fabric.
8. The true lbs. per sq. in. pressure, multiplied by the diameter of the opening, is constant for all three machines for the same fabric.
9. If the *diameter of opening* is taken into consideration and the *diaphragm error* is determined, it makes little difference in the results obtained what size of machine is used. The product of lbs. per sq. in. $\times$ the diameter is the same.
10. The bursting strength for any knit fabric, when found by the formulae as derived for each machine, is the same for all three machines.

Test Procedure

All test specimens were prepared and tested in the same atmospheric conditions in order to make the results compara-

tive. The figures shown in Table I are the averages of 10 breaks for the 1¼″ machine, five breaks for the 4″ machine, and three breaks for the 8″ machine. The same pressure gauge was used for each bursting machine. The rise in inches was measured

TABLE I

Comparison of Bursting Machines

	(*P*) Indicated Gauge Read. Lbs. per Sq. In. Fabric Diaphragm	(*e*) Diaphragm Error Lbs. per Sq. Inch	(*P* − *e*) True Lbs. per Sq. In. for Fabric	(*D*) Diameter of Opening	*P* − *e* × *D*
S.T. Jersey					
Mullen Tester	61	20.5	40.5	1.25″	50.6
4″ Machine	15	2.5	12.5	4.0″	50.0
8″ Machine	10	3.5	6.5	8.0″	52.0
D.T. Jersey					
Mullen Tester	69.5	20.5	49.0	1.25″	61.2
4″ Machine	18	2.5	15.5	4.0″	62.0
8″ Machine	11	3.5	7.5	8.0″	60.0
Pink Corset Net					
Mullen Tester	71	20.5	50.5	1.25″	63.1
4″ Machine	16	2.5	13.5	4.0″	54.0
8″ Machine	10	3.5	6.5	8.0″	52.0
6½ Net					
Mullen Tester	97	20.5	76.5	1.25″	95.6
4″ Machine	20.5	2.5	18.0	4.0″	72.0
8″ Machine	13	3.5	9.5	8.0″	76.0
4½ Net					
Mullen Tester	111	20.5	90.5	1.25″	113.1
4″ Machine	30	2.5	27.5	4.0″	110.0
8″ Machine	15	3.5	11.5	8.0″	92.0
3½ Net					
Mullen Tester	121	20.5	100.5	1.25″	125.6
4″ Machine	33	2.5	30.5	4.0″	122.0
8″ Machine	18.5	3.5	15.0	8.0″	120.0

and recorded for each break. The figures for the Grab Test in Table II are the averages of five breaks in the wales direction and five in the courses direction. The specimens were broken on a Scott Horizontal Tester, 400–800 lbs. capacity, using 1 × 1 × 1″ jaws, 1″ apart; speed of pulling jaws 12″ per minute. The 400 lb. capacity was used.

TABLE II

Bursting Strength vs. Grab Test

	$(P - e)$ True Lbs. per Sq. In. for Fabric	(V) Rise in Inches	(T) Burst. Str. Lbs. per In. of Width	1″ Grab Test—Lbs.	
				Wales	Courses
S.T. Jersey					
Mullen Tester	40.5	.575	12.7		
4″ Machine	12.5	1.55	13.1	23.8	12.8
8″ Machine	6.5	2.825	13.8		
D.T. Jersey					
Mullen Tester	49.5	.650	15.4		
4″ Machine	15.5	1.575	15.9	29.4	15.4
8″ Machine	7.5	3.025	15.6		
Pink Corset Net					
Mullen Tester	50.5	.575	15.8		
4″ Machine	13.5	1.616	13.8	18.4	11.6
8″ Machine	6.5	2.80	13.9		
6½ Net					
Mullen Tester	76.5	.625	23.8		
4″ Machine	18.0	1.675	18.3	35.6	19.6
8″ Machine	9.5	2.85	20.1		
4½ Net					
Mullen Tester	90.5	.675	43.5		
4″ Machine	27.5	1.80	27.6	42.6	30
8″ Machine	11.5	3.05	23.8		
3½″ Net					
Mullen Tester	100.5	.675	31.4		
4″ Machine	30.5	1.75	30.8	59.2	41
8″ Machine	15.0	2.95	31.4		

Diaphragm Error

The diaphragm error on the bursting machine is the lbs. per sq. in. necessary to stretch the diaphragm to the same relative position it is in when the fabric is ruptured. It is determined after each break by removing the broken sample and then allowing the pressure to be built up on the diaphragm until the same rise in inches is reached as for the break. The gauge reading at this point is the diaphragm error.

Derivation of Formula

Following is the procedure followed in deriving the bursting strength formula for each machine:

Let d = diameter in inches and P the internal pressure per sq. in. The total pressure which tends to produce rupture around the great circle will be $\frac{1}{4}\pi d^2 P$. Let T = the bursting strength expressed in pounds per inch of width; then the resistance to the pressure will be πdT. Since the resistance must be equal to the pressure:

$$\tfrac{1}{4}\pi d^2 P = \pi dT, \tag{1}$$

$$T = \frac{P}{4} d, \tag{2}$$

or

$$T = \frac{P}{2} r. \tag{3}$$

Since the formation of a perfect spherical surface is seldom obtained in the bursting test, where the rise in inches is equal to the radius, it is necessary to carry formula (3) further to fit actual conditions.

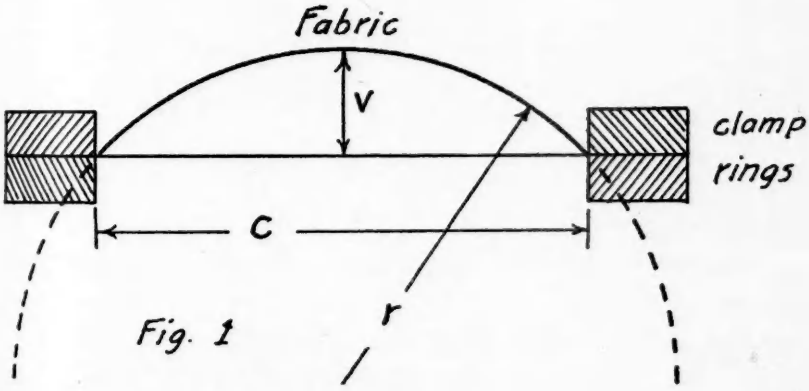

Fig. 1

By knowing the value of V, the rise in inches (see Fig. I) and C, the diameter of the opening, then r, the radius of the circle, can be found by the mathematical formula:

$$r = \frac{4V^2 + C^2}{8V} \tag{4}$$

which is the common means of computing the radius of a circle when the height of arc and length of cord are given.

Substituting for r, in formula (3)

$$T = \frac{P}{2}\left(\frac{4V^2 + C^2}{8V}\right) = \frac{P}{2}\left(\frac{V}{2} + \frac{C^2}{8V}\right), \tag{5}$$

which is the bursting strength formula for fabrics when it is assumed that the surface of a fabric under a fluid pressure does conform to a spherical surface.

Bursting Strength Formulae for

Mullen Tester (where $C = 1.25''$)	$T = \frac{P}{2}\left(\frac{V}{2} + \frac{.195}{V}\right)$,	(6)
4" Machine (where $C = 4''$)	$T = \frac{P}{2}\left(\frac{V}{2} + \frac{2}{V}\right)$,	(7)
8" Machine (where $C = 8''$)	$T = \frac{P}{2}\left(\frac{V}{2} + \frac{8}{V}\right)$,	(8)

References

1. *Mechanical Fabrics.* Haven, George B. John Wiley & Sons, Inc., N. Y.

2. *A.S.T.M. Specifications* D231–25T, paragraph 13.

3. F. R. McGowan and C. H. Hamlin, *Textile World,* Vol. 67, pp. 3285–7, May 1925.

4. Ibid.

5. *A.S.T.M. Specifications* D231–28T, paragraph 13.

"Obsolete machinery of however great beauty, or the newest machinery for making a fabric nobody wants, are unpleasant to our thoughts; but if by research we do not keep ahead of the times, we shall have both."—Dr. E. B. Millard.

"Pamilla Silver Cloth" and Technological Unemployment

By DR. GRINNELL JONES

Reading of that part of Dr. Jones' paper relating to the development of a new textile product, impells the query as to whether there may not be other known facts and principles, now invisible to practical textile men because they are too close to their daily jobs, that may become the basis of additional new textile finishes or products?
Dr. Jones is professor of chemistry at Harvard University. The subject of this paper, which he presented recently before the Northeastern Section of the American Chemical Society, was "The Chemist's Answer to Technological Unemployment," and the author has kindly permitted abstracting of the economic portion.

THE world now seems to have a surplus of cotton and of wheat, of copper and rubber and silver and wool and hogs and peanuts. And we have more mines, and blast furnaces and machine shops, more spindles, and more filter presses than we can keep in operation. And there are miles of empty freight cars standing quietly on sidings and hundreds of ocean steamers rusting at anchor. And there seem to be more people than are necessary to do the world's work. But of course this is absurd. There can not be too much wheat and too many flour mills, and bakeries to make bread and too many railroads to haul it to market and also too many people to eat it up. If we put it this way it seems obvious that the trouble is in a faulty organization of the world.

We have too many wars and too many weak banks which have been wrecked by speculation. We have too many taxes to kill the enterprise of business men and the purchasing power

of everybody, and too many people who are driven by fear to an unnecessary curtailment of normal buying.

Some people try to put the blame for the depression on the chemists, and especially the engineers, because they say we have made machines which have thrown men out of work. Of course we can not deny that the reorganization made necessary by the introduction of power-driven, labor-saving machines has been terribly hard on many individuals. The solution of the problem is, however, not less machinery but a bigger and broader life all around, including some adequate provision for the men displaced by labor-saving machinery.

Before 1800 the manufacture of clothing was a household art. Our Colonial grandmothers sheared the wool from the back of the sheep, then washed it with home-made soap, spun the yarn by hand and wove it into cloth on looms driven by the power of their feet and then sewed the cloth into suits and dresses. Then the invention of the steam engine was followed by the invention of power-driven spindles and looms and sewing machines which took the manufacture of cloth and clothing out of the home. The result has been an enormous increase in the amount and variety and quality of the fabrics available and used per capita, together with a great decrease in the fraction of human effort and time which has to be devoted to providing ourselves with clothes.

New Products—More Jobs

Of course we can not go backward and do not want to go backward. What is needed now is the creation of new useful and saleable articles whose manufacture will consume surplus raw materials, provide jobs for unemployed men, put the railroads to work and raise the standard of living for everybody. And, since Chemistry is the greatest creative science, chemists have the power to cure the depression if the financiers and politicians will give them half a chance. The chemist who discovered neon made television possible, and now television is ready to capture the fancy of the public and develop into a great new industry. The artificial cooling and air-conditioning of homes in the summer may become common in the near future.

and that is, of course, a branch of chemical engineering. Probably it will be a combination of a hundred or a thousand new things which will provide jobs enough to go around and lead us into a new and greater prosperity.

The Incentive

I am going to tell you the story of one of these new things which is already providing a market for some surplus cotton, and providing some jobs for men in factories and at the same time lightening the labors of housekeeping.

Mr. Richard Johnson came to me on behalf of the Pacific Mills with the statement that they had lots of textile machinery of all sorts in their mills which they were unable to keep in profitable operation. The competition was so keen in their regular lines that the profits were squeezed out. They wanted some new way of treating cloth chemically so as to adapt it to some new and specialized use—something which could be patented and trade-marked and sold at a profit of 5 cents or even 10 cents a yard. They suggested that I try to invent something of that kind. I assured them that I was not a textile expert, and they replied that, of course, they knew that but hoped that I would do something that any experienced textile chemist would know to be impossible.

The Idea in the Laboratory

And so with the help of Mr. Stearns we started work in old Boylston Hall. I am fortunate that I can plead the limited time available as an excuse for not confessing all of the foolish things we tried, but limit myself to the development of an idea which proved to have merit. After some false starts it occurred to me that we should try to treat a cloth so that it would protect silverware against tarnish.

We tried impregnating a cloth with the hydroxides of the metals which give insoluble sulfides: copper, cadmium bismuth, lead antimony, silver, zinc and others. At first we wrapped pieces of silver in cloth mordanted with these metals and exposed them under a bell jar to air containing hydrogen sulfide, or sulfur dioxide, or a mixture of both, or with solid sulfur

near at hand. All of these metals and some others had protecting power. For a while we hoped that we could use zinc, because the cloths treated with zinc hydroxide started white and stayed white, whereas all the others showed undesirable color effects. Zinc gave protection for short periods, but, when the experiments were continued for longer periods, zinc actually promoted tarnishing. The zinc apparently catches the hydrogen sulfide and then passes it on to the silver inside.

The officials of the Pacific Mills, although impressed by our experiments, said that they did not intend to put such a cloth on the market unless they could guarantee perfect protection against tarnishing under household conditions for two years, and asked me if they would be safe in making such a guarantee. I replied that the only way to be sure was to make the trial under household conditions. Therefore we prepared a large number of bags with cloths mordanted with various metals: copper, cadmium, silver, zinc, etc. and with different amounts of protecting agent per yard of cloth. Then we put clean strips of silver inside and sewed them up. One set of these bags was taken to my home and my wife put them away in her china closet. Other sets were sent to friends in cities where soft coal is burned, which causes rapid tarnishing of silver. One set was put on a back shelf in the news stand in the old South Station, while they still had a great canopy to catch the coal smoke and make it available to the public and to my bags. At the end of a year some of these bags were called in and opened. These experiments showed that zinc failed completely and the other metals gave some protection, but the only one which gave perfect protection was silver itself.

The Idea in the Mill

Then the problems of manufacturing a cloth mordanted with silver were taken up actively at the mill by a group of experienced textile chemists, and, although I kept in touch with the work, the credit for putting the cloth into production belongs to these men. Mr. Moran had general supervision of the work and was aided at first by Mr. Cote, then by Mr. Amick; later, Mr. Adams, Dr. Rupp and Mr. Barnard all shared the work and contributed to the solution.

When a second year had passed the experimental bags were called in again and opened, and again the cloths mordanted with silver showed complete and perfect protection and all the others had failed. Then a decision was made to put the new cloth mordanted with silver on the market. Fortunately for our purposes the price of silver had dropped substantially during the course of the work.

The cloth used was especially designed for the purpose. It is a good grade of cotton canton flannel, tightly woven and heavily napped. This cloth, after suitable scouring processes, is passed into a solution of silver nitrate, then through a squeeze roll to control the proportion of solution, then it passes into a hot sodium carbonate solution which precipitates silver oxide on and inside the fibre. The cloth is then washed and dried. The finished cloth contains about 9% by weight of silver. The cloth has a dark brown color—the natural color of silver oxide. The problem of standardizing the color has not yet been completely solved. Different lots do not match perfectly in shade; sometimes the front and back of the same piece are different; occasionally streaked or uneven colorings appear. The cloth darkens when exposed to sunlight or to hydrogen sulfide. It is traditional in the textile industry to be very fussy about matching shades and dying uniformly, and so the chemists at the mill worked months trying to standardize the color, but have not yet succeeded perfectly, although they do better now than they did at first. Finally they decided that this is not essential. All shades seem to be alike in protecting power. The product is, of course, patented (U. S. Patent 1,766,646) and trade marked under the name of Pamilla Silver Cloth.

Merchandizing the Product

The many problems which have arisen in connection with the marketing of the fabric have been ably handled by Mr. R. M. Everett of the Pacific Mills. It is made up into bags with drawstrings for plates, bowls and cups, and into rolls with pockets for flat silver. There are also chests with linings of Pamilla Cloth. It is distributed for the Pacific Mills through the sales organization of the Gorham Company, Providence, R. I.

Textile Foundation Research

The objectives of two more Textile Foundation researches, with brief mention of the methods of attacking the problems, have been released for publication. Both cover subjects of vital importance to the textile industry wherever located, and it is interesting to note that both of these studies are being conducted in England under the direction of eminent authorities.

"Mildew Prevention and Treatment"

EXPOSURE to varying intensity of light or heat and variable substances used in processing textiles may cause mildew to acquire quite different hues, but the ultimate ruinous effect is essentially the same. Owing to the costliness of textile mildew, considerable research, particularly in England, has been directed toward its elimination. Now a concerted attempt at mildew eradication is being supported by the Textile Foundation. This research has both the prevention and treatment of mildew as its objectives, states Bernard S. Gould, an M. I. T. graduate and Textile Foundation research fellow, who is working on the problem at the University of London, under the direction of Prof. Rainstrick, one of the leading English biochemists and bacteriologists.

"Textile mildew," Mr. Gould explains, "is an observable growth of microscopic plants similar to those found on overripe fruit, old tobacco and countless other articles. One angle of our problem is to develop, if possible, suitable antiseptics for preventing mildew by their incorporation into textile manufacturing processes. Previous efforts to that end have met with varied success.

"There is also the problem of dealing with the mildew once it has occurred, for often the damage is of so mild a nature that the fabric can be saved. Obviously it would be futile to

attempt any work without a basic knowledge as to the fundamental chemical nature of the mold and its products, especially the colored substances or pigments.

"In order to properly eliminate mildew discoloration a thorough knowledge of mildew reactions and properties is necessary. It would be useless to try to eliminate a yellow color by the use of alkali if that particular pigment were to turn violet under an alkaline stimulus. It would be equally as futile to try to wash out a water-insoluble pigment. The isolation and analysis of the pure pigments is absolutely essential.

"There is the possibility that our research may have an incidental value to the dye chemist. The formulae for such beautiful hues as are produced naturally by micro-organisms may, quite likely, be of benefit to the dye industry. Invariably micro-organisms synthesize the only unknown of a series of compounds and often the most interesting one of all. They seem to be able to twist the molecules as man is unable to do. Although molds would be a very uneconomical source of pigment for large scale work a study of these might lead to a later synthesis from natural products."

"Orienting Influences of the Benzene Ring"

"DYESTUFFS production revolves around the so-called 'benzene ring,'" it is explained by John S. Reese, Textile Foundation research fellow, who is working on the problem under Dr. Arthur Lapworth, professor of chemistry, University of Manchester, England. "Benzene occupies its fundamental position in the dyestuff industry because of its distinct and almost indestructible characteristics. It is frequently found doubled or tripled within itself. Furthermore it can easily take on new parts and thus be almost infinitely varied without losing its characteristic property. The benzene ring of six fundamental parts is pictured by the chemist as a hexagon. At each of the six points there is opportunity for variation through the addition of new parts or substituents.

"Rather oddly, these substituents, when added to the benzene ring, do not choose any of the six points at random but only certain ones, depending among other reasons on the nature

of the substituent which first locates itself. Efforts to describe the phenomenon of the orderly manner in which these new parts orient themselves have created the problem of the 'Orienting Influences of the Benzene Ring.'

"To produce a specific dye, a certain arrangement of particular substituents is necessary. Even when the desired arrangement is obtainable, others are likely to occur simultaneously, causing a considerable waste in the manufacturing process. Obviously, then, it is of great interest to the producer to control and direct effectively the addition to the benzene ring of the desired substituents.

"Among the substituents commonly introduced there is one whose entry is effected by sulfonation, a process important in manufacturing many dyes and also in the study of orienting influences. Hence, our research is investigating the sulfonation of benzoic acid, a substance closely related to benzene and differing from it only in the attachment of a well-known substituent to one of the six points.

"In the process of sulfonation a second and different substituent is added to one of the six points. In order to explain how and where the second substituent is added, it is desirable to know how fast the process occurs, another object of our research. We hope from these studies to contribute to an effective control of the point of entry of substituents to the benzene ring, thereby leading to more economical production of well-known dyes and possibly to the development of new ones."

"An invention is the application of known facts and principles in a new way. . . . Research on the other hand, is the search for new facts and principles which may subsequently be used in inventions."—Arthur Koehler.

X-Ray Analysis of Fibers:

Part I, Literature Survey

By WAYNE A. SISSON *

(*Conclusion*)

The March number of TEXTILE RESEARCH *carried Mr. Sisson's literature survey and references up to the year 1929 and it is here concluded.*
Following publication of the first instalment of the survey, The Textile Foundation decided to make available complete mimeographed copies of Mr. Sisson's literature survey. Those desiring copies should address E. T. Pickard, Secretary, The Textile Foundation, Commerce Building, Washington, D. C.

1929

(*a*) Cellulose

Structure

MARK AND MEYER [102] put forward a model for cellulose which they claim will give intensities of the x-ray diagram in agreement with those observed. They calculated the length of the micelle to be about 500 A. U. and the width about 50 A. U. They consider the reactions which this structure will lead to and classify them into two types: (*a*) micellary surface reactions, and (*b*) molecular or "permutoid" reactions. In the first kind the reagent penetrates between the micelles without attacking their internal structure. The orientation may, however, be disturbed and the fibre diagram changed to a Debeye-Scherrer diagram. In the second kind of reaction the reagent penetrates the whole structure and attacks specific groups at various points of the lattice. The same type of information was published by Mark [103] in another article. There are 25 to 30 parallel chains in each micelle and these are 50 to 100 glucose residues long and are held together by primary valence bonds. Mark points out that the strength is only 5 to 10% of that indicated by the known energy required to rupture 0-bridges of inorganic compounds. The low strength is probably due to slippage rather than rupture when the cellulose is broken. Meyer and Mark [104] also gave a good summary and discussion with references and x-ray patterns in a further article.

* *Senior research fellow of The Textile Foundation.*

Animal and β-Cellulose

Mark and Susich [105] investigated the structure of tunicin and β-cellulose. Both were found to give a cellulose fibre structure. They also obtained information on the arrangement of the planes on the crystal lattice by stretching sheets of tunicin. X-ray patterns are included in the article. Andress [106] published a mathematical discussion of the interpretation of the intensities of the x-ray diagrams of cellulose.

Review

Hauser [107] gave a review of Mark and Meyer's work on cellulose. Davey [108] discussed briefly the structure of cellulose in relation to other organic compounds and Clark [109] the structure of cellulose and silk in relation to x-ray work on the general problem of polymerization.

Cotton

Clark, Pickett and Farr [110] published a note describing some x-ray observations upon the development and growth of cotton fibres and the various qualities or grades of cotton. Sponsler [111] gave a discussion of the mechanism of cell wall formation as revealed by x-ray analysis.

Silk Fibroin

A preliminary account of some x-ray work on silk fibroin was reported by Kratky.[112]

(*b*) Chemical Reactions

Cellulose Hydrate

Burgeni and Kratky [113] published a long article on their work relating to cellulose hydrate. They described improvements in technique and experiments on the stretching and rolling of cellulose films. Weissenberg published two notes [114, 115] on the lattice of hydrated cellulose. He gives the dimensions $a = 14.66$, $b = 8.89$, $c = 10.35$ Å., $\alpha = 90°$, $\beta = 90°$ and $\gamma = 85°$. The unit cell contains eight $C_6H_{10}O_5$ units.

Mercerized Cellulose

Andress [116] reports mercerized cellulose to belong to the monoclinic system with the dimensions $a = 8.1$, $b = 10.3$, $c = 9.1$ Å. and $\beta = 62°$. The structure is similar to that of native cellulose. The difference lies in the different positions of the main valences to one another. He concludes that the change occurring during mercerization of natural cellulose is the rearrangement of the main chains to more stable relative positions, which consists of a sideways change in the relationship of the chains with respect to one another. Trogus and Hess [117] investigated the product obtained when cellulose is treated with an ammoniacal copper solution. Two compounds which give fibre diagrams were isolated. Upon washing with water the diagram of mercerized cellulose is obtained. Mark and Susich [118] by the use of very intense x-rays found that two intermediate compounds are formed in the course of 5 minutes upon mercerization.

Methyl-Cellulose

Trogus and Hess [119] published an important article on the structure of methylated cellulose. Trimethylcellulose gives a fibrous pattern with the dimensions a = 21.3, b = 25.6 and c = 11.3 Å. The unit cell contains 24 C_6 groups. They give an interesting discussion relating the data obtained for methylcellulose to the structure of cellulose.

Cellulose Acetate and Nitrate

Hess and Trogus [120] discussed the behavior of cellulose triacetate in various solvents. In some cases they found an expansion of the lattice at right angles to the fibre which returned to the original dimensions upon drying. Miles and Craik [121] examined with x-rays a complete range of nitrated ramie samples. In many cases a fibre diagram was lacking and their results were difficult to explain.

Enzymic Decomposition

Faust and Karrer studied the enzyme decomposition of cellulose by means of x-rays and reported their results in two papers.[122]

1930

(*a*) Structure

Mark and Meyer [123] published a further paper on the structure of cellulose, repeating data published in a previous paper.[102] Sponsler and Dore [67] were the first to advance the idea that cellulose is built up of long parallel chains and they pointed out that the short spacings indicated by x-ray diagrams represent periodicities along these chains. The ideas set forth in this original paper were repeated in a German periodical.[124] An x-ray examination of *Valonia ventricosa* by Sponsler [125] proved to be an important contribution to the knowledge of the way in which the cellulose chains are laid down in the cell wall. This information is possible since the cellulose in Valonia is deposited in relatively large sheets instead of small cylinders. This material gives a clear separation of some of the important reflections which are very close together in the ordinary fibre diagram, and enabled Sponsler to describe the unit cell of cellulose with considerable certainty. Bragg [126] commented upon the importance of this paper and showed the correlation between Sponsler's and Mark's cell dimensions.

Sponsler's cell dimension—a = 10.7, b = 12.2, c = 10.3 Å.

Mark's cell dimension—a = 8.7, b = 10.3, c = 7.8 Å. Mark and others deduce a monoclinic structure while Sponsler and Dore assume an orthorhombic cell; however, there is very little difference between the two.

As the result of the probable structure of the cellulose in the cell wall, the plane of the glucose units lies at an angle of about 45° to the wall surface which gives a surface studded with hydroxyl groups. The possible influence of this surface on cell activity was pointed out by Sponsler.[127]

Micro-Structure

Eckling and Kratky [128] developed a micro-camera and showed that x-ray patterns of individual cells of ramie fibre were the same as that of a bundle of fibres.

Micelle Chemistry

Fox [129] discussed the x-ray structure of cellulose and its esters and the application of these facts to the mechanism of the chemical reactions of cellulose.

Long Spacings

The possibility of a new method of attack upon cellulose was opened by Clark and Corrigan,[130] who discussed the application of magnesium radiation (Ka = 9.86 A. U.) for obtaining x-ray diffraction patterns of the long spacings of cellulose. They report the finding of spacings 274, 168, and 156 Å.

β-Cellulose

Eggert and Loft [131] examined with x-rays β-cellulose prepared from cane sugar. In the swollen condition the x-ray pattern exhibits the image of an amorphous substance. In the dry condition a typical pattern of cellulose is obtained, which is fibrous if dried in a deformed condition.

Electron Diffraction

Dauvillier [132] discussed the technique of obtaining electron diffraction patterns of thin films of cellulose materials. The diffraction patterns obtained for cellulose products could not be correlated with x-ray patterns. Trogus and Holberschadt [133] claim that small pin holes in cellulose films give diffraction patterns and that the results obtained by other investigators were pin hole patterns rather than the true space lattice diffraction patterns.

Paper Cellulose

Hess and Trogus [134] discussed the structure and orientation of cellulose and cellulose hydrate in different layers of paper and the change produced by mechanical action. They published the results of further studies [135] on samples of paper prepared from cellulose and cellulose hydrate. Cellulose fibres orient themselves with respect to the surface of the paper. Interference patterns of the paper fillers show the filler crystallites to be oriented on the fibres.[136]

Wool

Ewles and Speakman [137] published their results on the x-ray examination of the fine structure of wool. Astbury and Woods [138] showed that all animal hairs furnished two types of x-ray patterns depending upon whether the hairs are stretched or not, and showed the transformation to be reversible. α (unstretched) = 5.15 A. U. along fibre axis. Side spacings = 9.8 and 27 A. U. β (stretched) = 3.4 A. U. along fibre axis and 9.8 and 4.65 A. U. side spacings. On the basis of these dimensions a structure is worked out.

Silk Fibroin

Simmers [139] reports that fibroin itself does not contain a definite space lattice, but is associated with a definite crystalline material. In order to

decide whether the crystalline portion of fibroin crystallizes before or after the spinning act, Brill [140] took x-ray patterns of a live silk worm's glands, freshly spun silk and the dried material. Crystalline patterns only appeared after drying.

Rayon

Levin and Rowe [141] published an excellent illustrated review of the x-ray investigations on rayon.

General Articles

During 1930 there were several excellent reviews of past work and general articles on the structure of cellulose. Steude [142] published such a review. Bragg,[143] in a lecture before the Royal Institution, gave a very good discussion of x-ray work on cellulose. The same information was published in another article,[144] and also by Eccles and Bragg,[145] who discussed the structure of cellulose in the light of the x-ray as well as the effect of chemical reactions upon this structure. Medard [146] called attention to the similarity between silicates and cellulose fibres. Clark [147] gave a review of the structure of cellulose. The properties of rayon were discussed from the x-ray standpoint. The growth and classification of cotton and also the structure of various kinds and sections of wood were discussed. A comparison of the structure of natural silk and various kinds of rayon was made from the standpoint of x-ray analysis. Mark [148] discussed the analysis of x-ray fibre patterns, the determination of fibre properties with x-rays, and the structure of cellulose.

Textiles

Mark[149] gave a review of the development of the application of x-rays to cellulose fibres, with x-ray patterns of the various textile fibres. A general discussion of the application of x-rays to research on textile fibres was presented by Clark.[150]

(*b*) Chemical Reactions

Hess, Trogus, Osswald and Dziengel [151] published a report of some x-ray investigations on cellulose derivatives. They showed that the transformation of acetylcellulose I to acetylcellulose II was reversible, and that nitrocellulose in the fibrous form suffers a lattice change upon treatment with organic liquids.

Methylated Cellulose

Hess and Trogus [152] reported the results of x-ray investigations upon the fibre diagram of trimethylcellulose and triacetylcellulose. Mark and Susich [153] state the most probable value for methylcellulose to be 10.3 A. U., instead of 10.7 as reported by Hess and Trogus.[152] Thus methylation does not change the length of the cellulose chain.

Nitrated Cellulose

Miles and Craik [154] published further data similar to that reported in a previous publication.[121] They showed that the x-ray diagram of nitrated

ramie containing up to 7.5% nitrogen was the same as the original fibre, and the nitration was probably of an intermicellar nature. Above 7.5% nitrogen, physical disintegration of the fibre takes place. Trogus, Hess and Katz [155] published a paper on the lattice deformation of nitrocellulose, and showed the effect of various organic solvents upon the x-ray pattern. The application of x-rays to the problem of cellulose and its derivatives was discussed in an address by Katz.[156]

Mercerization

Susich and Wolff [157] examined, with x-rays, cellulose fibres treated with various concentrations of alkali for different periods of time and a range of temperatures.

1931

(*a*) Structure

During the year of 1931 there was very little published on the structure of cellulose itself. Most of the work was on cellulose derivatives.

Yashida and Matsumotto [158] published an article discussing their work on the structure of cellulose. No new information of importance was given. Astbury and Marwick [159] discussed the structure of native and hydrated cellulose in relation to sugars. The structural difference between native and mercerized cellulose is pointed out. Very interesting crystallographic data on related compounds are given.

More complete data than that given in his first note on Valonia [123] was furnished by Sponsler.[160] The cellulose in Valonia is deposited in layer rather than in cylindrical form as is usually found in plant cells. From the data obtained in this material Sponsler concludes that the 6.10 planes are tangential and the 5.40 planes radial to the cell wall. He reasons that the same arrangement is found in the cell wall of plants.

Wool

Astbury and Street [161] found the structure of wool, hair, quills, etc., to be the same and to undergo similar reversible changes on stretching. The β pattern is obtained after 60% extension. It is pointed out that the most prominent periodicity along the fibre axis of the α form is 5.15 A. U., which is the same as cellulose. Astbury [162] published a further article containing the same type of information. He points out that the crystallites of wool are so small that wool is called a colloid. The lattice changes upon elongation are discussed and the interesting fact pointed out that the transformation from α to β keratin is associated with a molecular elongation from 5.15 to 10.2 A. U.

Wood Cellulose

Schmidt [163] investigated the orientation of cellulose crystals in different woods. He found that in general the more compact the wood the greater the alignment, and the greater the tensile strength.

General

A historical review of the application of x-rays to the textile industry was given by Hall.[164] In another article Hall [165] discussed the application

of x-rays to textiles, and the micellar structure of cotton and rayon are correlated with the fibre properties. Zeidenfeld [166] described the apparatus and technique necessary to produce x-ray fibre photographs using a very short exposure. An article on the generation and application of x-rays for textile investigations was published by Boxser [167] and a general review of the structure of fibres with special emphasis on animal or protein fibres was given by Astbury.[168]

Luft [179] found that cactus thorns gave an x-ray diagram of the same character as "fossil wood." Yashida and Matsumotto [180] claim that the A_2 spot on the equator is of Kβ origin and the A_1 spot due to the adsorption edge of silver bromide.

(*b*) Chemical Reactions

Nitrocellulose

Trillat [169] published an article on the lattice transformations of nitrocellulose and their generality in cellulose compounds. Some excellent x-ray patterns showing the relation between the concentration of nitric acid used for nitration and the type of x-ray pattern obtained, were given by Hess and Trogus.[170] Desmaroux and Matheau [171] discussed the types of x-ray patterns obtained from nitrated cotton cellulose containing various percentages of nitrogen. They showed that the trinitrate gave two circles. Polarized light showed the outer part of the cotton fibre to contain the trinitrate while the inner section contained the lower nitrate. Hess and Trogus [172] found a fibre period of 25.4 A. U. for trinitrocellulose. They believe the type of x-ray diagram depends upon the nitration operation.

Alkali-Cellulose

Hess and Trogus [173] showed that two new fibre diagrams are obtained upon treating cellulose with sodium hydroxide-water solutions. Sodium cellulose I is formed in solutions containing up to 19% sodium hydroxide and sodium cellulose II in solutions containing over 21% sodium hydroxide. Fibre periods for the various alkali celluloses are given, and the action of potassium and lithium hydroxide are discussed. Katz and Dirksen published two papers,[174, 175] on the x-ray analysis of cellulose fibres swollen with lithium thiocyanate solutions of varying concentrations. They show that for dilute solutions the salt is adsorbed on the surface of the micelle while for higher concentration addition products are formed.

Reactions—General

Trogus and Hess [176] showed by x-ray examination that the hydrazine ethylenediamine and tetramethylenediamine form addition products with cellulose fibres which are decomposed upon treatment with water. Schramek and Schubert [177] claim that there is a quantitative relationship between the x-ray diagram and the degree of mercerization, and that x-rays can be used as a measuring stick to estimate the degree of mercerization. The use of x-rays in studying the reactions of cellulose was pointed out by Hess and Trogus.[178]

Fibre Period

Hess and Trogus [181] have shown that for cellulose and its derivatives the fibre periods are integral multiples of the value 5.15 A.U., the factor

being 2, 3, 4, and 5. 5.15 corresponds to the length of a glucose group. Therefore, they conclude that the value 5.15 has a closer relationship to the constitution of cellulose than the accepted value of 10.3 A. U. This agrees with the general theory of growth structures that the identity period along the direction of growth is usually the shortest side of the unit cell.

1932

(*a*) Structure

Astbury and Marwick [182] have continued the work started by Sponsler [125, 160] on Valonia with special emphasis on the correlation of microscopic and x-ray data. In a lecture before the Society of Dyers and Colorists, Mark [183] reviewed the molecular structure of cellulose as worked out by Mark and Meyer.[77, 102] The relation between structure, tensile strength and dying of the fibre was also discussed.

Cotton

X-ray diffraction analysis and microscopic observations with ordinary and plane-polarized light were used by Farr and Clark [184] in an attempt to establish a relationship between the degree of variation in configuration of wall material of cotton fibres and the regularity in orientation of the structure units.

Adsorption

Ohara and Matsunga [185] found that gold crystals, which cause dichroism of the silk, are distributed in disorderly fashion among the micelles of the silk.

Review

A general discussion of the most advanced x-ray apparatus and technique, the interpretation of fibre patterns and a review of the recent results on the x-ray analysis of cellulose derivatives was given by Miles.[186] The type of x-ray diffraction patterns obtained from vegetable and animal fibres was illustrated by Astbury.[187] Astbury and Woods [188] reviewed the recent work on the structure of textile fibres and put forward a general theory of fibre structure. Fibres usually consist of fully extended or folded molecules and the type of structure has considerable influence upon the physical properties of the fibre.

(*b*) Chemical Reactions

Trogus, Hess and their coworkers were responsible for papers showing the effect of non-aqueous solvents on the x-ray patterns of cellulose derivatives,[189] the effect of alcohol on alkali cellulose,[190] the process of Xanthate formation from cellulose [191] and the type of cellulose pattern obtained from Cellotriose.[192] An x-ray study of cellulose acetabactes xyliuum was made by Khauvine and Champetier.[193]

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183. The Significance of the New Cellulose Model (Molecular Structure) for the Technical and Dyeing Properties of the Fiber. Mark, H., *J. Soc. of Dyers and Col.*, 58, 53–59 (1932).

184. Cotton Fibers. II. Structural Features of the Wall Suggested by X-ray Diffraction Analysis and Observations in Ordinary and Plane-polarized Light. Farr, W. K. and Clark, G. L., *Contributions from Boyce Thompson Institute*, 4, 273–95 (1932).

185. The Submicroscopic Structure of Silk. II. X-ray Investigations of Dichroism of Silk. Ohara, K. and Matsumoga, Y., *Bull. Inst. Phys. Chem. Research* (*Tokyo*), 11, 466–76 (1932).

186. Methods and Results of the X-ray Investigations of Sub-crystalline Materials. Miles, F. D., *J. Soc. Chem. Ind.*, 51, No. 31, 247T (1932).

187. X-ray Diffraction Photographs of Vegetable and Animal Fibers. Astbury, W. T., *Phot. J.*, 318–24 (1932).

188. Molecular Structure of Textile Fibers. Astbury, W. T. and Woods, H. J., *J. Textile Inst.*, 23, 17–34T (1932).

189. Contributions to the Knowledge Concerning the Solution of Organic Substances in Non-aqueous Solvents. Trogus C., Tomonaie, F. and Hess, K., *Z. physik. Chem.*, B16, 351 (1932); B17, 241 (1932); B16, 374 (1932).

190. Behavior of Alkali Cellulose in the Presence of Alcohol. Trogus, C. and Hess, K., *Cellulosechemie*, 12, 81–83 (1932).

191. Cellulose Xanthate Formation. Hess, K. and Trogus, C., *Cellulosechemie*, 12, 84–85 (1932).

192. Contribution to the Knowledge of Cellotriose. Dziengel, K., Trogus, C. and Hess, K., *Ber.*, 65, 1454–57 (1932).

193. X-ray Study of the Cellulose of Acetabectes Xyliuum. Khouvine, G., Champetier, G. and Sutra, R., *Compt. rend.*, 194, 208–9 (1932).

"If the electrical engineers can find and assist Steinmetz, or Whitney, or Langmuir; and the medical research institutes can cherish Noguchi and Carrell, need we despair at the prospect of finding one such genius for our own work, and of doing as much for him?"—Dr. E. B. Millard.

Abstracts and Bibliography

This section is compiled under the direction of the Committee on Abstracts and Bibliography: Prof. E. R. Schwartz, Chairman, Dr. W. E. Emley, Prof. Louis A. Olney.

The Arrangement

Abstracts and Bibliography are arranged alphabetically by major subject under the following classifications:

I. Fibres (Synthetic and Natural) and Fibre Analysis.

II. Yarns and Fabrics.

III. Chemical and Other Processing (Not Otherwise Classified).

IV. Research Methods and Apparatus.

V. Economic Research and Miscellany.

Subjects are followed by name of author, and the abbreviated or complete title of the publication is followed by the year, volume, issue number or date, and the page number or numbers.

A key to abbreviations of publications abstracted was published in Vol. III, No. 1, Nov., 1932, pp. 58–9, and should be preserved for reference as it will not be published again in this volume. Abbreviations of additional publications abstracted are published in issues of their initial use.

Abstracts

I. Fibres (Synthetic and Natural) and Fibre Analysis

Cotton Fibres at Various Stages of Maturity: Microscopic Investigation of. A. P. Zakoshchikov, G. A. Korzheniovskii and M. G. Ruitikov. *Trans. Middle Asiatic Sci. Inst. Cotton Culture, Ind. Irrigation, Byull.*, 1931, No. 50, P. 15–43; *Chem. Abs.*, 1932, V. 26, P. 5988.

Cotton fibre at 40 days of age has the same structure as fibre from mature plants; it responds to mercerizing as mature cotton and has the same swelling coefficient in Schweitzer reagent and in 80% H_2SO_4. Thus cotton fibre has the same industrial value 35–40 days before the bolls open as after maturity. Only 15–16 days after blooming cellulose appears in cotton. As the cellulose appears and increases in quantity the proteins decrease. (W)

Felting of Wool: Fundamental Causes and Their Operation. (Wollverfilzung: ihre Grundlagen und Auswirkung.) H. Reumuth. *Mell. Textilber.*, 1933, V. 14, No. 1, P. 23–27.

An article which discusses the felting of wool fibres from the fundamental and practical standpoint. Photomicrographs illustrate certain of the points made. The author affirms that felting action can not be attributed solely to the scale interlocking of immediately adjacent fibres. (S)

Hair: Hysteresis of Moisture Adsorption. R. Fricke and H. Marquardt. *Kolloid Z.*, 1932, V. 60, P. 124–9.

The vapour pressure-concentration isotherms obtained for human hair-water systems in air by the van Bemmelen method show marked hysteresis loops. The hysteresis can be made to disappear by careful removal of air in a high vacuum. The agreement of this result with the work of other investigators on different systems is discussed. (Copied complete from *J. T. I.* abstract section, Dec., 1932.) (S)

Hemicelluloses: Differentiation of. L. F. Hawley. *J. Ind. and Eng. Chem.*, Oct., 1932, P. 1190.

Hemicelluloses fall into two groups: (1) those incrusting substances not closely associated with the cellulose, and containing in practically all cases a uronic acid, and (2) those very intimately associated with the cellulose and never containing a uronic acid. These two groups are accurately separated in the Cross and Bevan cellulose determination, provided that there is no pretreatment of the material with either acid or alkali before chlorination. The name 'polyuronide,' suggested by Candlin and Schryver, should be applied to all those in the first group containing uronic acid, and, for the second, a new term 'cellulosan' is proposed. (S)

Oxycellulose and Its Identity with B-Cellulose and Cellodextrin. E. Paternò. *Atti. accad. Lincei*, 1932, V. 15, P. 20–6; *Chem. Abs.*, 1932, V. 26, P. 4946.

The products formed by treating cellulose with various oxidizing agents ($KMnO_4$, NaOCl) are identical with products formed by the action of

H_2SO_4; all dissolve in 8–10% Na_2CO_3 and are precipitated as transparent gelatinous product by acid. The so-called solutions of oxycellulose in soda are really suspensions; oxycellulose is a true colloid. (W)

RAMIE: DEBARKING AND DEGUMMING BY CHEMICAL MEANS. P. Horton. *J. Ind. and Eng. Chem.*, Oct., 1932, P. 1162.

A chemical method for removing the bark from ramie permits the simplification of machinery to be used in the process of purification. The bark can be removed by means of strong alkalies or strong oxidizing agents, but at the same time the fiber is ruined for any practical purpose. Acids cannot be used for the same reason. The bark is successfully removed without injury to the fiber by digestion with dilute solution of ammonium hydroxide and sodium sulfite. This combination is being studied on a larger scale to obtain cost data. (S)

RAYON: COMPOSITION OF. E. Paternò. *Atti. accad. Lincei*, 1932, V. 15, P. 186–9.

The solubility of various rayons in 18% NaOH varies from 25–30%. The solubility in other alkalies is also reasonably constant: e.g., in 4% solutions, soly. in NaOH is 5.9%; in $Ba(OH)_2$, 4.7%. Viscose is not hydrocellulose but is a mixture of oxycellulose and another form not yet identified. (Copied complete from *Chem. Abs.*, 1932, V. 26, P. 5203.) (W)

SILK: SUBMICROSCOPIC STRUCTURE OF. I. EXPERIMENTS ON DICHROISM. II. X-RAY INVESTIGATION OF DICHROISM OF SILK. III. STRUCTURE OF COCOON SILK AND ITS CHANGE BY BOILING OFF. K. Ohara. *Bull. Inst. Phys. Chem. Rsch., Tokyo*, 1932, V. 11, P. 466–76, 769–71, 941–55; *Chem. Abs.*, 1932, V. 26, P. 5212, 5762.

Gold and silver deposited on silk and reduced by the vapor of hydrazine hydrate and daylight, show marked dichroism in the central layers. A cross-section of silk dyed by gold shows under daylight a structure having four layers, which seem to be attributed to the degree of dispersion of gold particles or the aggregation of micelles in silk. Gold crystals are distributed in disorderly fashion among the micelles. (W)

SILK FIBROIN: CHANGES IN SOLUBILITY AND ABSORPTION SPECTRA OF, CAUSED BY TIN WEIGHTING. J. L. Southard and E. L. Tague. *J. Home Econ.*, 1932, V. 24, P. 995–1002.

Weighting in silk forms an insoluble complex which causes solution of much of the protein absorption in the ultra-violet decreases more with dilution and exposure as the percentage of weighting increases. Two distinct zones of absorption indicate that silk protein consists of two distinct fractions. (Copied complete from *Chem. Abs.*, 1933, V. 27, P. 193.) (W)

SISAL HEMP, PLIABLE: CHEMICAL PROCESSES. Er. Reip-Sined. *Rev. gen. sci.*, 1932, 43, P. 579–87; *Chem. Abs.*, 1933, 27, P. 605.

In order to render sisal hemp from the Sudan pliable, it is necessary to free the fibres from gums and resins. Gums have not been satisfactorily removed, either by retting or fermentation. The resins can be largely removed by the action of alkalies or of hydrocarbons, but alkalies attack the fibre. The gums are chiefly anhydrides, insoluble in water and ether, and

are hydrolyzed by dilute acids to reducing sugars. The resins are amorphous, fusible by heat, insoluble in water, soluble in alcohol, chloroform and ether; some are weakly acidic. Sisal hemp is further discussed from the chemical and commercial standpoints. (W)

VISCOSE RAYON: CROSS-SECTION. S. Hase. *J. Soc. Chem. Ind., Japan* (Suppl.), 1932, V. 35, P. 367B.

To express the complexity of the shape of the cross-section of viscose rayon the author proposes the use of a new coefficient, λ, which is defined by $\lambda = L/L'$, or $\lambda = 0.282 \times L/\sqrt{A}$, where L = the circumference of the section, A = the sectional area and L' = the circumference of a circle having the same area as A. The relation between λ and the coagulation viscosity is discussed. When the coagulation bath liquor contains zinc sulphate, λ becomes larger as the coagulation velocity becomes slower, whilst in the case of coagulating baths containing magnesium sulphate, or magnesium sulphate and sodium sulphate in addition to sulphuric acid, λ is independent of the coagulation velocity, but becomes larger as the content of magnesium sulphate increases. The effect of sulphates on λ seems to increase in the order ammonium < sodium < magnesium < iron < zinc. (Copied complete from *J. T. I.* Abstract Section, Dec., 1932.) (S)

VISCOSE RAYON: PHYSICAL TEST OF. Z. Kawata. *J. Soc. Chem. Ind. Japan*, Suppl. Binding, 1932, V. 35, P. 220–1.

Steeping rayon in H_2SO_4 of various dilution conen's. and drying at 65–70° causes a decrease in strength and elongation with increasing acid concentration. The form of the strength-elongation curve is different for samples tested under varying temperature and humidity, but the area enclosed by the curve (work done by the sample) is constant. With rayon spun in a stretched condition the strength increases but the elongation and work done decrease. With rayon desulfured with Na_2S solution, the elongation increases, but strength changes very little and the work done decreases slightly. (Copied complete from *Chem. Abs.*, 1932, V. 26, P. 4948.) (W)

WOOL: THE SULFUR AND NITROGEN OF. Eleanor Winton and Rachel Edgar. *Iowa State Coll. J. Sci.*, 1932, V. 6, P. 395–405.

The literature review lists 55 references and includes a table giving the analysis for sulfur, or nitrogen, or both, and a description of about 200 samples of wool analyzed between 1840 and 1931. Twenty-nine samples were analyzed by the authors. Sulfur is not uniformly distributed from tip to root of a fibre. The percentages of sulfur in these 29 samples varied from 2.62 to 3.78, and the percentages of nitrogen from 15.81 to 16.35. Blank determinations must be made on the sample of wool if nitrogen or sulfur content is to be used as a basis for proximate analysis of mixed goods. (Copied complete from *Chem. Abs.*, 1932, V. 26, P. 6147.) (W)

II. YARNS AND FABRICS

LEAD-WEIGHTED SILK FABRIC: POSSIBLE HEALTH HAZARD OF. L. T. Fairhall and J. W. Heim. *J. Ind. Hyg.*, 1932, 14, P. 317–27.

The amounts of lead removed from lead-weighted silk by various fluids (perspiration, saliva, saline, urine, and water) were determined by the

chromate method. If the lead was present as silicate the ash was treated with hydrofluoric and sulfuric acids; the residue was dissolved in concentrated potass. hydroxide, diluted, and the lead precipitated with hydrogen sulfide. The tin which was invariably present remained in solution as potass. sulfostannate. The lead was converted to chromate and titrated with sod. thiosulfate. If the quantities were extremely small the micro-method was used. The average amount of suspended lead was 1.83 mg. per 100 cc., while the amount of lead in true solution was only the trace detected by microchemical means. The urine and feces of four subjects wearing the lead-weighted fabrics for two months were subjected to analysis. No excretion of lead occurred in any of the subjects. (Copied complete from Chem. Abs., 1933, 27, P. 847.) (W)

VISCOSE THREADS: STUDY OF THE MECHANICAL PROPERTIES OF. M. Coyand. *Russa*, 1932, 7, P. 881–91.

From a study of the effects of tensile stresses and moisture on the elongation and retraction of viscose threads, the author deduces that in order to work viscose without trouble, the following rules should be followed as closely as possible: (1) reduce tension as much as possible; (2) the working tension having been determined, maintain it absolutely uniform and regular; (3) it is not advisable to work viscose in too moist an atmosphere; (4) it is absolutely essential to work in an atmosphere of constant humidity. (Copied complete from *Chem. Abs.*, 1933, 27, P. 605.) (W)

III. CHEMICAL AND OTHER PROCESSING (NOT OTHERWISE CLASSIFIED)

CLOTHES MOTH LARVAE: EFFECT OF YEAST ON. W. Coleman. *J. Econ. Entomol.*, 1932, 25, P. 1242.

At a constant temperature and relative humidity (25° and 45–65% respectively) the growth of larvae of the webbing clothes moth (Tineola biselliella) is greatly accelerated by supplementing its diet of woolen cloth or raw wool with dehydrated pulverized brewers' yeast, administered by sprinkling it lightly over the cloth or wool. (Copied complete from *Chem. Abs.*, 1933, 27, P. 848.) (W)

COLOR QUALITY AND ITS CONTROL. (Lichtechtheit: Uber, und ihre Normierung.) Dr. Rein. *Mell. Textilber.*, 1933, V. 14, No. 1, P. 27–30.

A continuation of this series dealing with the control of color quality, in this case dealing particularly with various types of dyes and including a standard chart printed in full giving the eight types noted in the article for comparison. Of particular interest is a series of spectrophotometric charts showing the effects of exposure to light on certain dyes in Barcelona, Kobe, Bombay, Assuan, Oslo, Mexico, La Paz, and Melbourne. (S)

DIRECT DYEING PHENOMENA: COMPLEMENTARY CONTRIBUTION TO THE THEORY OF. Justin Mueller. *Tiba*, 1932, V. 10, P. 659–67; *Chem. Abs.*, 1932, V. 26, P. 6142.

"Auto solution" is explained and dyeing with direct colors is conceived as a phenomenon of autosolution, rather than due to reactions of chemical groups in the fibre. (W)

DYE AND COLOR MEASUREMENT. O. Heinrich. *Z. ges. Textil-Ind.*, 1931, V. 34, P. 690–2; *Chem. Abs.*, 1932, V. 26, P. 6142.

A method is described for determining the degree of dispersion of dyes on the fibre. The degree of dispersion is important in determining the leveling power of the dye and the economy of use. (W)

DYEING OF ACETATE RAYONS BY SUSPENSION DYESTUFFS: ACTION OF ADDITIONS IN. K. Lauer. *Kolloid-Z.*, 1932, 61, P. 91–100.

Dyeing experiments were made on acetate rayon with α- and β-amino- and 1, 4- diamino-anthraquinone, in the presence of aromatic disulfonates. The latter increases the degree of dispersion and the negative charge of the dye, which was used in a suspension of particles mainly 0.2 to 0.4 microns. Distribution experiments on the disulfonates between solution and silk showed no clear relations. In the absence of disulfonate the dye is reversibly adsorbed at the surface of rayon, and is then dissolved in the rayon, reaching saturation in 45 minutes. The disulfonates increase the time. They cause a change in color tone. (Copied complete from *Chem. Abs.*, 1933, 27, P. 846.) (W)

DYES AND PIGMENTS: ABSORPTION AND FLUORESCENCE. R. Toussaint. *Tiba*, 1932, V. 10, P. 589–91.

Investigations of the absorption spectra of colouring matters carried out by means of a photo-electric cell show that each can be represented by an 'absorption V.' The horizontal strokes correspond to practically zero absorption and the maximum absorption is shown by the apex. The effect observed by the eye depends on the position of the absorption V in the spectrum and on the inclination of the two branches. A study of this method of characterising colour shows that the common conceptions of colour circles, dominant and complementary colours, etc., are unsatisfactory. Mixtures of two colours may be represented by a W-type of graph. Certain pigments, such as barium sulphate, give two absorption V's situated in different parts of the spectrum. The energy absorbed is transmitted either in the form of heat or fluorescent light. All colouring matters show some fluorescence but the intensity of fluorescence varies greatly, and in many cases the fluorescent radiation does not fall in the visible part of the spectrum. The wave length of the fluorescent radiation is always greater than the wave length corresponding to the point of maximum absorption. (Copied complete from *J. T. I.* Abstract Section, Dec., 1932.) (S)

KIERING AND BLEACHING PROCESS. A. J. Hall. *Am. Dye. Reptr.*, Jan. 2, 1933, P. 1.

Following some reflections on the somewhat tedious and not altogether satisfactory methods at present being employed for the removal of natural and added impurities as found in grey cotton fabric, the writer was fortunate enough to secure the translation of a very interesting report by N. V. Filopov and B. S. Voronkov (*Investia Textilnov Promushlenosti i. Torgovli*, 1930) dealing with the development and large-scale adaptation of an accelerated bleaching process in Russia for the 4th Government Cotton-Trust. The contents of this report are especially useful insofar as they indicate that the usual kiering and bleaching processes are capable of much improvement, and it is felt that the information given will be valuable to all connected with the wet processing of cotton goods. (S)

LIGNIN: CHEMISTRY OF. Max Phillips and M. J. Goss. *J. Ind. and Eng. Chem.*, Dec., 1932, P. 1436.

Alkali lignin from corncobs is subjected to dry distillation in a reduced atmosphere of carbon dioxide at a maximum temperature of 400° C. The following results, representing the average of five experiments (calculated on the basis of dry lignin), are obtained: aqueous distillate, 11.7 per cent; oily distillate, 28.3; carbonized residue, 50.5; gas, 9.3 (by difference).

The aqueous distillate contains acetic acid, acetone, methanol, and catechol. The yield of the first three compounds (calculated on the basis of dry lignin) amounts to 0.30, 0.10, and 0.65 per cent, respectively.

The oil is successively extracted with 5 per cent sodium bicarbonate and 5 per cent sodium hydroxide solutions. In the sodium bicarbonate extract, acetic acid and catechol are definitely identified. In the sodium hydroxide extract the following compounds are identified: phenol, o-cresol, guaiacol, creosol, 1-vinyl-3-methoxy-4-hydroxy benzene, 1-n-propyl-3-methoxy-4-hydroxy benzene, and a dimethoxycarboxylic acid ($C_8H_6O_2(OCH_3)_2$).

The fraction of the oil remaining, after the extraction with 5 per cent sodium bicarbonate and 5 per cent sodium hydroxide solutions, is steam-distilled. The steam-volatile neutral fraction, upon oxidation with potassium permanganate, yields anisic acid. In the steam-nonvolatile neutral fraction, n-nonacosane is identified. (S)

MOLECULES FOR THE TEXTILE INDUSTRY: BUILDING OF. R. E. Rose. *Am. Dye. Rptr.*, 1933, V. 22, No. 2, P. 47–54.

The author indicates how dyestuffs are built up molecularly and how this structure may be indicated diagrammatically in the fashion usually employed by organic chemists. From comparatively simple structure, such as triphenyl methane to the complex structure of aniline black, Dr. Rose chases groups of sulphonic acid ethyl and soforth around the benzene ring. (S)

ORGANIC COLORING MATTERS: PHYSICOCHEMICAL AND PHYSIOLOGICAL INVESTIGATIONS WITH. André Meyer. *Bull. soc. chim.*, 1932, 51, P. 1202–5.

A warning against conducting investigations on organic dyes unless the identity of the dye is known, as trade names are frequently deceptive, and unless the purity is known, as commercial mixtures blended with other dyestuffs or with non-dyes are common. Specific instances are given of faulty work reported which results from failure to observe these precautions. (Copied complete from *Chem. Abs.*, 1933, 27, P. 605.) (W)

RAW WOOL: SCOURING OF, IN THE LIGHT OF PRESENT-DAY SCIENTIFIC KNOWLEDGE. J. Vallée. *Tiba*, 1932, 10, P. 859, 861.

Attention is drawn to the possibility and advisability of removing colloidal pigmentary matter from raw wool by suitable acid treatment, thus eliminating the necessity of bleaching. This can be effected by treatment with the fatty alcohol sulfonates, which are current commercial products. The chief difficulty in the commercial application of such a process is to obtain equipment which will stand the high acidity (pH of about 3). (Copied complete from *Chem. Abs.*, 1933, 27, P. 605.) (W)

SCOURING ACTION OF SOAP ON SILK. R. Tsunokaye. *J. Soc. Chem. Ind. Japan*, Suppl. Binding, 1932, V. 35, P. 405–10; cf. *Chem. Abs.*, 1932, V. 26, P. 5762.

In the degumming of silk the soap and its hydrolyzed products remain combined with the fibre physically and chemically and influence the nature of the silk. The substances which affect the silk are fatty acids, alkali and soap, the alkali destroying the luster and decreasing the strength and elongation, while the fatty acid increases the elasticity. Adsorbed saturated fatty acids hold the color of the scoured silk, while unsaturated fatty acids, because of their oxidation, change its color. Adsorbed fatty acids also influence the degree of weighting of the silk. The effect of adsorbed soap on the strength, elongation and elasticity of the silk is various, but it is not so liable to undergo oxidation on the silk fibre. Fatty acids and not soap are the cause of scroop on scoured silk. (Copied complete from *Chem. Abs.*, 1932, V. 26, P. 6144.) (W)

STARCH PASTES: CONSISTENCY CHANGES IN. George V. Caesar. *J. Ind. and Eng. Chem.*, Dec., 1932, P. 1432.

A new method of obtaining a continuous record of the consistency of a starch paste is described. Tables and curves are submitted showing the consistency changes in commercial grades of tapioca flour, sago, corn, potato, and wheat starches. Their characteristics are discussed. The effect of aqueous alkali upon tapioca pastes is studied, and the latest theories respecting the behavior of starch in water are briefly presented. (S)

TENDERING OF CELLULOSE WHEN EXPOSED: INFLUENCE OF CERTAIN VAT DYESTUFFS ON THE. C. M. Whittaker. *J. Soc. Dyers and Col.*, 1933, V. 49, P. 9–19.

The tenacity of cellulose decreases with increase in fluidity and copper numbers, so that these chemical tests for exposed cellulose may be relied upon in a great measure as a correct indication of the degree of deterioration. Open air exposure has a greater deteriorating effect than exposure under glass; impure or industrial atmospheres have a greater deteriorating effect than suburban atmospheres, whilst pure country or seaside atmospheres have the least deteriorating effect. The order of relative catalytic effect of the different vat dyestuffs in the deterioration of cellulose is practically the same wherever the yarns are exposed. Certain vat dyestuffs tend to inhibit the deterioration of cellulose on exposure; no case is recorded of a blue casement curtain tendering. The higher concentrations of vat dyestuffs appear to have a slightly greater deteriorating effect; this latter point requires further investigation. Direct cotton colors have an inhibiting effect on the deterioration of cellulose on exposure. Bleached cotton is highly degraded by a relatively short exposure to sunlight and atmosphere; cotton is not appreciably, if at all, superior to viscose, and it is only the lower initial wet strength of viscose that makes the latter appear to deteriorate more. The fact that vat blue viscose casements are never returned because of tendering is ample proof that viscose dyed with safe vat dyestuffs is eminently suitable for casement fabrics. Since sunlight, humidity, and impurities in the atmosphere are the causative factors, a test by which the relative effect of these factors could be separated would be of the greatest assistance in determining the border-line vat dye-

stuffs, such as Caledon Red BN, which do give rise to isolated cases of complaint by the consumer. (S)

IV. Research Methods and Apparatus

Breaking Strength: Prediction of Lea, from Single-Thread Test Test Results. V. Venkataraman and Nazir Ahmad. *Tex. Mfr.* 1933, V. 59, P. 15.

The lea strength, as obtained by Gregson's method, is generally greater than the observed lea strength when the lea ratio

$$\frac{\text{Lea strength (lb.)} \times 100}{160 \times \text{mean single-thread strength (lb.)}}$$

is less than 70, and less than the observed lea strength when the lea ratio is greater than 70. The percentage differences between the calculated and the observed lea strengths are comparatively small only if the lea ratio lies between 67 and 77. In almost all other cases the percentage differences are quite large—i.e., Gregson's method breaks down completely. Even when the lea ratio lies between 67 and 77 the agreement between the calculated and the observed lea strength is not always very good—a discrepancy of 5% is quite common, of 10% not uncommon. There is apparently no relation between the counts and "lea ratio," so that unless a lea test is actually performed it is not possible to foretell the "lea ratio" of a yarn. In view of the above conclusions, the only practical application of Gregson's method is that, when both tests are performed, it can serve as a check upon the lea test results in those cases in which the lea ratio lies between 67 and 77. It cannot be used to predict the lea strength in any and every case. Even in the case of similar yarns, spun from duplicate lots of the same cotton, the percentage differences between the calculated and the observed lea strength may sometimes assume large values. This is probably due to the different degrees of irregularities in the structure of yarn which are revealed more minutely by the single-thread test than by the lea test. (S)

Heavy Metals and Traces of Impurities in Cotton Fabrics: Detection of. H. M. Chase. *Am. Dye. Rptr.*, 1933, V. 22, No. 3, P. 49.

A paper presented at the annual meeting of the A. A. T. C. C. in December 1932 and concerned with methods of micro-chemical and spot analysis. Reference to Chamot and Mason's work in the former field and to Feigl's work in the latter is made together with details of certain definite techniques. Considerable space is devoted to the estimation of copper. (S)

Linen Industry Research. *Tex. Mfr.*, 1933, V. 59, P. 9.

Research on linen problems is proceeding from improvement in growing flax, in fibre production from flax, control and testing in processing, and study of requirements of goods in use. A brief review of the subjects under consideration by the British Linen Industry Research Association was given by the chairman and the director at the recent annual meeting of the Association. Mr. H. L. M'Cready, the chairman, referred to various subjects: flax growing; flax-fibre production; bleaching, dyeing, and finishing; spinning and weaving; sectional co-operation; linen shoe-uppers. (S)

RESILIENCE OF WOOL: REPORT ON A METHOD FOR MEASURING THE. C. G. Winson. *J. T. I.*, Dec., 1932, P. T386.

An attempt has been made to measure the resilience of a volume of wool by enclosing it in a thin spherical rubber membrane and submitting it to the mechanical action of a surrounding atmosphere whose pressure is made to vary in a cyclic manner.

The area of the loop relating the pressure and volume of the mass of wool (expressed as a fraction of the volume under zero pressure), seems to serve as a measure of the resilience of the wool. This measure is in fair agreement with expert opinion.

The work does not claim to be exhaustive, but was designed to investigate the possibility of measuring resilience with accuracy. Many difficulties have still to be overcome in order to make the method thoroughly reliable. In particular the following points should be inquired into: (1) the effect of humidity and conditioning on resilience; (2) the effect of length; (3) the effect of previous treatment of the wool with various reagents; (4) the effect of stretching of the fibres. (S)

SIZED COTTON, THE ANALYSIS OF: THE DETERMINATION OF ZINC AND MAGNESIUM, AND SOME QUALITATIVE TESTS. Arthur Geake. *J. T. I.*, Nov., 1932, P. 279.

The paper notes, after an introduction and summary, a discussion of the electrolytic method for the determination of zinc; the oxine method for the determination of zinc and magnesium; the magnesium content of raw cottons; the diffusion of zinc chloride from warp to filling during storage, and qualitative tests for zinc, magnesium, aluminum, china clay, and fluorine. (S)

ULTRA-VIOLET LIGHT ON ARTIFICIAL SILK: INCIDENCE OF. J. M. Preston. *Rayon Record*, 1931, 5, P. 651.

The mercury vapour arc lamp is the most efficient and convenient source of ultra-violet light. Filters, consisting of coloured films of gelatin, or glass plates coloured with cobalt and nickel oxides, are necessary in examining the fluorescence of textile materials. Dyestuffs may be placed in different orders of fastness when examined in different sources of light. A dyestuff with an absorption in the long wave ultra-violet, but transmitting the short wave ultra-violet, when exposed to a light source rich in short wave ultra-violet, but weak in long wave ultra-violet, would be little affected and vice versa. (Copied from *J. Soc. Dyers and Col.*, V. 48, 1932, P. 318.) (S)

ULTRA-VIOLET RADIATION TEST: INDUSTRIAL APPLICATIONS OF THE. John Muir. *The Ind. Chem.*, 1932, Sept., P. 310; Oct., P. 348; Dec., P. 437.

A series of three articles indicating the considerable amount of work which has recently been done in various fields of research toward a thorough evaluation of the reliability and application of filtered ultra-violet radiation in analysis. The articles are intended to review current practice and are amplified by notes from the writer's experience. Textiles and dyestuffs are listed as industries in which ultra-violet radiation testing is especially valuable. The first article is concerned with the apparatus and general method, while the second one is devoted entirely to the textile industry. Among the specified items mentioned are the examination of piece goods,

fibre identification, dyestuffs on textiles, fastness to rubbing, fastness to light, certain problems in connection with bleaching and with textile printing. The third article of the series concerns lubricating oils and greases. (S)

V. Economics and Miscellany

Industrial Research: A Banker's Viewpoint of. Broderick Haskell, Jr. *J. Ind. & Eng. Chem.*, Aug., 1932, P. 953.

A very interesting presentation from the banker's standpoint of the present status of industrial research and future trends, covering research financing and publicity. With regard to textiles the author states: "the textile industry, for example, has not made any notable and fundamental advances in the art of cloth manufacture for generations. Machinery built from 40 to 50 years ago . . . is still actively used in several of the most efficient and economically operated mills in the country. Stimulated by war-time demands the industry was grossly over-built with plants that in no important way differed from their earlier contemporaries . . . the overcapacity that exists in almost every direction of our industrial structure is a great challenge to research, and, when in the future we look back at these dark days, I am confident we shall find that those companies accomplishing the most by way of research will have led the way toward recovery." (S)

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I. Fibres (Synthetic and Natural) and Fibre Analysis

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A brief review. (Copied complete from *Chem. Abs.*, 1933, 27, P. 827.) (W)

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A brief discussion with fourteen excellent photomicrographs of the natural silk from various sources, particular emphasis being placed on the dicotyoploca. (S)

II. Yarns and Fabrics

Fabrics: Photography of Faults. *Tex. Mfr.*, Jan., 1933, P. 5.

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A brief description of rubber thread and the use of lastex in modern garments. (S)

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The article is largely a review of the important points established in the Control of Shrinkage Section of the October 17, 1932, *Daily News Record*. The question of pre-shrinkage takes precedence. (S)

TEXTILES: INSECT PESTS OF. G. O. Clark. *Tex. Mfr.*, 1933, V. 59, P. 11–12.

Different kinds of damage which various insect pests give rise to. Methods of prevention of damage or destruction of the pests. The value of mothproofing. (S)

III. CHEMICAL AND OTHER PROCESSING (NOT OTHERWISE CLASSIFIED)

ANTI-CREASE CELLULOSIC MATERIALS: SYNTHETIC RESINS AND. Ellis Clayton. *J. Soc. Dyers and Col.*, 1932, V. 48, P. 295–98.

A communication giving somewhat more detailed discussion of the processes involved. (S)

AZO DYES DERIVED FROM QUINOLINOLS, AND ADDITIONAL RULE FOR AZO DYES IN GENERAL: A NEW RULE FOR THE CHROMABILITY OF. C. Courtot and H. Hortman. *Bull. soc. chim.*, 1932, 51, P. 1179–99; *Chem. Abs.*, 1933, Vol. 27, P. 846. (W)

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Chemical degradation of cotton, linen, and rayon is measured by the viscosity of its cuprammonium solution, and a standard comparable test has now been laid down. (S)

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A brief patent review. (Copied complete from *Chem. Abs.*, 1933, Vol. 27, P. 605.) (W)

DYEING OF WOOL-SILK FABRICS: CONDITIONS FOR THE. Victor Aufrette. *Russa*, 1932, 7, P. 903.

A brief discussion of optimum conditions. (Copied complete from *Chem. Abs.*, 1933, Vol. 27, P. 605.) (W)

Book Reviews

"La Lana" (Wool). Oscarre Giudici. 184 pages with 29 illustrations. S. Lattes & Co., Torino, Italy. Reviewed in *Mell. Tex. Mo.*, 1932, 4, P. 348. (W)

Micro-Chemical Laboratory Manual. By F. Emich. Translated by F. Schneider. Pp. xvi + 171 + Index. New York: John Wiley and Sons, Inc. London: Chapman and Hall Limited. 1932. Price 18s. 6d. net.

The translator remarks in his preface that to many English-speaking chemists the term "micro-chemistry" is associated with quantitative organic analysis and the name of Pregl. Actually, of course, the subject in its widest sense was not unknown to Faraday, who termed it "minute" chemistry, and it was extensively developed in the latter part of the last century by Emich and his co-workers. The present volume, essentially of practical character, is based upon the second edition of the German text, with additions, and does not include that part of the subject covered by Pregl's book. While certain other sections of this branch of chemistry are dealt with in greater detail in Chamot and Mason's "Handbook of Chemical Microscopy," some still remain hitherto untouched by an English text-book. Much special apparatus is not essential; "every chemist who possesses a microscope can carry out qualitative micro-analysis, and where a micro-balance is available, quantitative inorganic determinations are possible." These two instruments, together with such other pieces of apparatus, often improvised, as are necessary for the performance of ordinary micro-chemical operations, are described, together with their mode of usage, in the first half of the book. An equal space is devoted to the description of practical exercises, 76 in number, and covering qualitative and quantitative inorganic tests and, on the organic side, qualitative and preparative work. Finally, a few pages contributed by Dr. Feigl provide an introduction to "spot" analysis. In view of the increasing appreciation of the advantages appertaining to small-scale operations, this volume is certainly one for which there is a place in our literature, to serve as a guide towards the skill, ingenuity, and cleanliness which are particularly necessary. (Copied complete from *The Ind. Chem.*, 1933, V. 9–96.) (S)

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